CLAIMS

What is claimed is:

1. The process of obtaining of mono-crystalline gallium-containing nitride from the gallium-containing feedstock in a supercritical ammonia-containing solvent with mineralizer addition, , the process comprises the first step of transition of the feedstock from the metallic form to the polycrystalline gallium-containing nitride, and the second step of crystallization of the gallium-containing nitride through gradual dissolution of the feedstock and selective crystallization of gallium-containing nitride on at least one mono-crystalline seed at the temperature higher than that of the dissolution of the feedstock, and consequently bulk mono-crystalline gallium-containing nitride is obtained.
2. The process according to claim 1, characterized in that said azides of Group I elements are LiN_3, NaN_3, KN_3, CsN_3 or their mixtures.

3. The process according to claim 1, characterized in that convection and chemical transport between the two zones are suppressed in the first step, and the saturation degree of the supercritical solution with respect to soluble gallium compounds is reduced.

4. The process according to claim 1, characterized in that the reduction of the saturation degree of the supercritical solution with respect to soluble gallium compounds is obtained by adjusting the opening of the crucibles containing metallic gallium, placed in the dissolution zone.

5. The process according to claim 1, characterized in that the temperature ramping in the dissolution zone at the beginning of the first step is higher than 0.1°C/min, and then the temperature in the first step in the dissolution zone is maintained higher than 350°C, preferably higher than 400°C.
6. The process according to claim 1, characterized in that the temperature in the dissolution zone is maintained higher than the temperature in the crystallization zone in the first step, and in the second step the temperature in the crystallization zone is raised to a higher value than the temperature in the dissolution zone.

7. The process according to claim 1, characterized in that the temperature ramping in the crystallization zone at the beginning of the second step enables a certain dissolution of the seed(s).

8. The process of controlling the growth rate of the bulk mono-crystalline gallium-containing nitride in the process according to claim 1, characterized in that the process comprises the first step of transition of the feedstock from the metallic form to polycrystalline gallium-containing nitride, while convection and chemical transport are suppressed, and then the second step in which the conditions of dissolution of the feedstock and the saturation degree of the supercritical solution with respect to soluble gallium compounds are controlled, and after convection is evoked, the feedstock gradually dissolves and selective crystallization of gallium nitride on at least one mono-crystalline seed is carried out at the temperature higher than that for the dissolution of the feedstock, as long as the feedstock has completely or partially run out, and bulk mono-crystalline gallium-containing nitride is obtained.

9. The process of forming a substrate from bulk mono-crystalline gallium-containing nitride obtained by a method according to claim 1, characterized in that the thus obtained bulk mono-crystalline gallium-containing nitride layer is then sliced and polished.

10. The process according to claim 1, characterized in that the bulk mono-crystalline gallium-containing nitride layer crystallized on the seed has the thickness of over 1 mm, preferably over 3mm.

11. The process according to claim 1, characterized in that a protective layer is deposited on the thus obtained substrate by the crystallization method from the gaseous phase, preferably using the MOCVD or HVPE method.

12. The process according to claim 1, characterized in that a protective layer from $Al_xGa_{1-x}N$, where $0 \leq x < 1$, is deposited on the thus obtained substrate.

13. The process according to claim 1, characterized in that the annealing process is carried out in a single step or in multiple steps until the desired level of impurities (such as hydrogen and/or ammonia or ions formed from the impurities formed during the crystallization and/or annealing process) is reached.

14. The process for removing impurities from bulk mono-crystalline gallium-containing nitride obtained by a method according to claim 1, characterized in that the thus obtained mono-crystalline layer of bulk gallium-containing nitride has the thickness of over 1 mm, preferably over 3 mm, and then the layer is sliced into wafers which are

    (a) rinsed in the environment of supercritical ammonia-containing solvent, water or carbon dioxide or

    (b) rinsed in the environment of liquid ammonia-containing solvent, water or carbon dioxide or

    (c) subject to the action of gaseous hydrogen, nitrogen or ammonia

    with at least some impurities being washed off from the mono-crystalline nitride.

15. The process according to claim 1, characterized in that the process for removing impurities by

    (a) rinsing in the environment of supercritical ammonia-containing solvent, water or carbon dioxide or

    (b) rinsing in the environment of liquid ammonia-containing solvent, water or carbon dioxide

    is aided by the application of ultrasounds.

16. The process according to claim 1, characterized in that a wire saw is used for slicing bulk mono-crystalline gallium-containing nitride.

17. The process of obtaining a bulk mono-crystalline gallium-containing nitride from the gallium-containing feedstock in a supercritical ammonia-containing solvent characterized in that the feedstock is in the form of metallic gallium or mono-crystalline gallium-containing nitride, and the ammonia-containing solvent is in the form of ammonia with addition of mineralizer in the form of the Group I (IUPAC, 1989) elements and/or their mixtures, and/or their compounds, especially those containing nitrogen and/or hydrogen, there are two temperature zones in each step of the process, and the feedstock is placed in the dissolution zone and at least one mono-crystalline seed is deposited in the crystallization zone, and following the transition of the solvent to the supercritical state, the process comprises the first step of transition of metallic gallium to the solution at the first temperature, and then the second step of selective crystallization of gallium nitride on the feedstock in the form of mono-crystalline gallium-containing nitride, and then the third step of crystallization of the gallium nitride, through gradual dissolution of the feedstock and selective crystallization of gallium-containing nitride on at least one seed at the temperature higher than that of the dissolution of the feedstock, while all the vital components of the reaction system (including the feedstock, seeds and mineralizer) invariably remain within the system throughout the whole process, and subsequently bulk mono-crystalline gallium-containing nitride is obtained.